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Clinical usefulness of color Doppler imaging in the management of the neck region vessels in patients with intraocular tumors – preliminary report

Monika Modrzejewska[1], Grażyna Wilk[2], Aleksander Falkowski[2], Danuta Karczewicz[1], Barbara Górecka-Szyld[2]

[1] Department of Ophthalmology, Pomeranian Medical University in Szczecin, Poland
[2] Department of General and Dental Radiology, Pomeranian Medical University in Szczecin, Poland

Author's address: Monika Modrzejewska, Department of Ophtalmology, Al. Powstańców Wlkp. 72, 70-111 Szczecin, e-mail: monika_modrzej@op.pl

Summary

Background: The purpose of the study was to assess the clinical usefulness of color Doppler ultrasonography (CDU) examinations of the neck vessels in patients with intraocular tumors as well as to establish whether the changes in these vessels had an influence on further ophthalmologic procedures.

Material/Methods: Clinical ophthalmological examinations such as visual acuity, anterior segment and ocular fundus, as well as color Doppler ultrasonography of the bulbar and neck region vessels were performed on 38 patients, aged 44-70 years with eyeball tumors. Localization, size, vascularization of the intrabulbar tumors and big vessels of the neck region were analyzed.

Results: In 28 patients, choroidal melanoma was identified, and the vascularity of tumor mass was monitored in 10 patients after brachytherapy. Compression or infiltration of jugular veins or carotid artery were not observed. Severe internal carotid artery stenosis due to arteriosclerosis was detected in 5 patients, but no one was suggested to be operated on first in Vascular Surgery Department.

Conclusions: Color Doppler ultrasonography should be the first choice technique in the neck vessels and intrabulbar tumors imaging. Visualization of the mass lesions vascularity and the evaluation of amplitude of blood flow velocity allows to monitor the effectiveness of their therapy. It was found that this technique is useful in deciding upon the method of treatment in patients with coexisting arteriosclerosis.

Key words: color Doppler ultrasonography • intraocular mass lesions • neck vessels imaging • arteriosclerosis

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Background

In ophthalmology, color Doppler ultrasonography (CDU) is used as a method supplementing the evaluation of mass lesions, their differentiation, applied treatment and its effectiveness. This technique plays an important role in imaging of the vascularization and blood flow velocity in bulbar tumors, coexisting with non-transparent optical media [1]. The advantage of CDU is also the ability to monitor the course of treatment, especially during the brachytherapy application. Moreover, CDU allows to assess the lesions in the neck region vessels. The presence of a critical stricture of the carotid artery may cause serious complications, including cerebral stroke. This is important in the planning of ophthalmologic treatment [2].

The aim of the study was to assess the clinical usefulness of color Doppler ultrasonography (CDU) examinations of the neck vessels in patients with intraocular tumors, as well as to establish whether the changes in these vessels had an influence on further ophthalmologic procedures.

Materials and methods

Thirty eight patients, including 20 women aged 55-70 and 18 men aged 50-68 years with intrabulbar tumors, were examined. In all patients, the examinations of the neck vessels were performed with the use of 7.5-10 MHz linear transducer and sector transducer, with color Doppler (duplex Doppler) in supine position, with the head tilted backwards and slightly turned to the opposite side. The probe was arranged in longitudinal and transverse projections. The internal jugular veins, common, external and internal carotid arteries (CCA, ECA, ICA) as well as the vertebral arteries were visualized. The blood flow spectrum was observed in Doppler imaging and the degree of arterial stenosis was evaluated in percentage. Stricture of the ICA by more than 50% of diameter of the lumen was diagnosed as hemodynamically essential, but treated conservatively. Stenosis of less than 50% of diameter was regarded as hemodynamically unessential.

In ophthalmologic examinations, the corrected visual acuity, anterior segment, ocular fundus (in indirect ophthalmoscopy), B-scan and CDU were assessed. To exclude the retrobulbar extension and the presence of metastases in patients with malignant intrabulbar mass suspicion, computer tomography (CT) and magnetic resonance (MR) of the eyeball, orbit and central nervous system (CNS) were performed.

Imaging of the vascularity in intrabulbar tumors was performed with the use of the same linear transducer. The probe was applied to the eyeball through the gel layer without causing pressure. The signal from the examined arteries and veins was obtained by the position of Doppler sound on the eyeball looking straight ahead. During the examinations, the angle between the ultrasound beam and the blood flow direction was 30 degrees. The blood flow velocity was assessed inside the tumor vessels. In case of the presence of vascularity in pathological changes, the amplitude of velocity of Doppler shift was estimated. In CDU systolic velocity, pulsation index (PI) and resistance index (RI) were measured. All patients gave a written consent for the necessary examinations to be performed.

Results

The results of the investigations are presented in table 1.

In 28 patients with clinical recognition of choroidal malignant melanoma, the USG image showed a well-delineated, most often elevated structure, with inhomogenus echogenicity attached to the retina and in some cases situated on the single pedicle (fig 1). Inside the tumor mass, the presence of intense arteriovenous shunts was observed. These vessels were presented as a low-resistance flow (fig 2).

The next examined group consisted of 10 eyes in 10 patients with choroidal melanoma malignum diagnosis. In those patients, CDU monitored the effectiveness of brachytherapy treatment. Good reaction to brachytherapy was observed as the decrease of tumor mass as well as diminishing of the vessels pulsation and finally its disappearance (total closure of vessels in shunts) (fig 3).

Neither compression, nor infiltration of jugular veins and carotid arteries was visible. Atheromatous changes in the carotid arteries were diagnosed in all patients. Hemodynamically unimportant ICA stenosis (less than 50% of diameter) was observed in 33 patients (including the group after brachytherapy), while hemodynamically

Table 1. Clinical diagnosis, number of patients, changes in intrabulbar and neck region vessels.

Clinical changes	Average age	Number of patients		
		pathological intrabulbar vessels	ICA stenosis	
Choroidal melanoma	61	28	≤ 50%	24
			≥ 50%	4
Choroidal melanoma after brachytherapy	55	10	≤ 50%	9
			≥ 50%	1

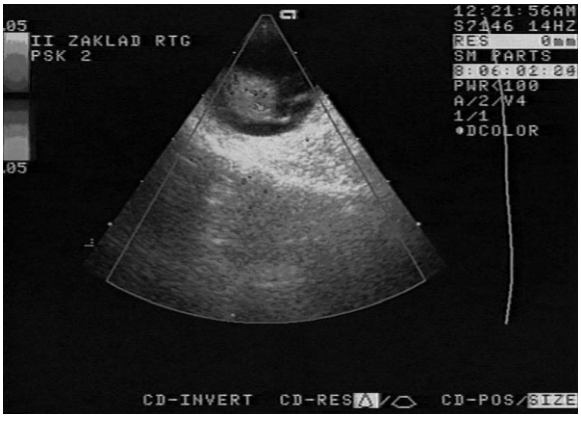

Figure 1. Intrabulbar tumor, arterio-venous shunts.

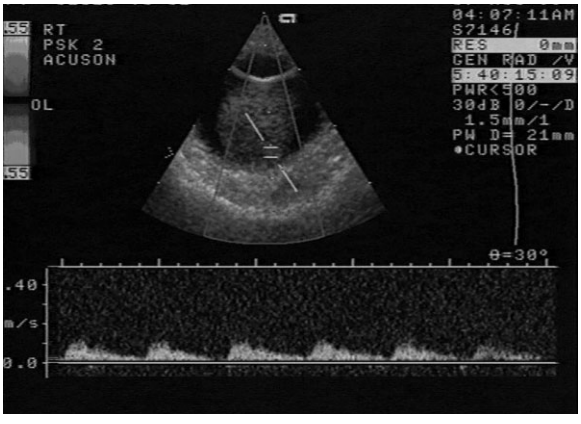

Figure 2. Intrabulbar mass – blood flow spectrum.

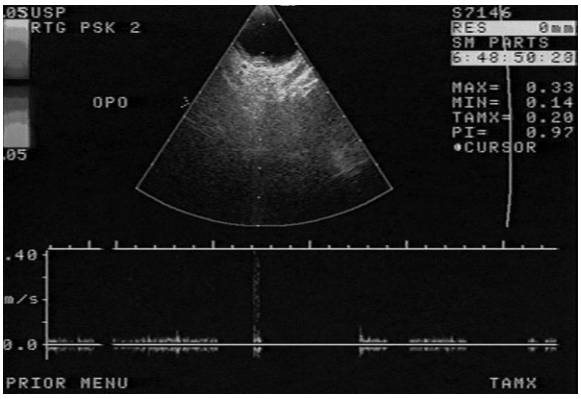

Figure 3. Intrabulbar melanoma after brachytherapy – lack of the blood flow 1 year after radiation – obliterated shunts.

essential one (over 50-58% in diameter) in 5 patients [fig. 4]. These 5 patients were treated conservatively in the Angiology Outpatient Clinic.

CT and MR examinations excluded the retrobulbar extension of the tumors as well as metastases.

Discussion

In the evaluation of intrabulbar mass lesions together with the clinical evaluation of the patients, the first additional examinations are still indirect ophthalmoscopy and ultrasonographic methods, especially in nontransparent optical media. The additional techniques such as fluorescein and indocyanine angiography, CT as well as MR allow to identify tumor morphology, CDU estimates tumor vascularity and its internal blood flow velocity [3]. A new sonographic method is harmonic imaging [4]. Pathological changes seen in bulbar malignant melanoma tumors are most often diagnosed as: hemangioma, focused hemorrhage, solid degeneration lesions and choroidal metastasis [5]. A characteristic feature of a choroidal melanoma in CDU is a curved route of vessels with an intense low-resistance blood flow. Doppler spectral pattern of blood flow velocity in these vessels is characterized by decreased wave amplitude and rapid, low-resistance blood flow. We observed low velocity values in systolic time and sustained fast blood flow in diastole, typical of arteriovenous shunts, having no muscular membrane. The results of our CDU examinations in the analyzed group of patients with choroidal malignant melanoma are the same as reported in the literature [6, 7]. The results of brachytherapy in all patients were observed as a disappearance of vascular pulsation and finally obliteration of the arteriovenous shunts. In the literature, and in our opinion, such images confirm the effectiveness of radiation [6,8].

In case of choroidal metastases in CDU, the obtained Doppler signals are similar to these in choroidal melanoma. The difference between them is higher frequency of the amplitude and faster blood flow in the metastatic tumor [6]. This diagnosis may have a crucial significance for the treatment, because a malignant melanoma must be irradiated immediately, while in case of a metastasis the primary focus must be found to institute further oncological procedures.

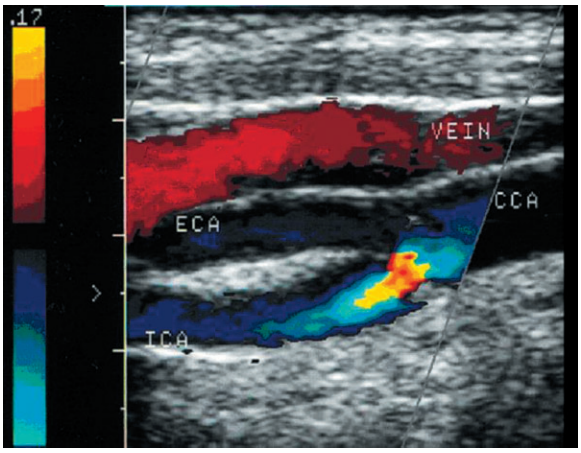

Figure 4. Common carotid artery (CCA), internal carotid artery (ICA), external carotid artery (ECA) and internal carotid vein. 50% stenosis of the internal carotid artery.

The applicability of CDU in the neck region is emphasized in the literature [9]. This technique reveals not only the character and velocity of blood flow, but also its disturbances caused by compression or infiltration of the vessels due to malignant tumors [10]. In our material, we observe only disturbances of the blood flow in the carotid arteries connected with atheromatous changes coexisting with the orbital tumors. Sclerotic plaques in the carotid arteries were observed in all patients within the studied group, but only in 4 patients the changes were hemodynamically essential. After angiological consultation, these patients underwent conservative treatment (CDU examinations every 6 months). The majority of our patients presented ICA strictures not exceeding 50% of diameter and did not need any vascular intervention. It is mentioned in the literature that critical strictures causing over 70% reduction in diameter may increase the possibility of a stroke, and therefore must be operated on first [11]. In the studied group of patients we did not observe such pathology.

Color Doppler imaging is a quick, noninvasive, repeatable method, which allows to detect intrabulbar tumors and changes in the neck region vessels. An additional advantage of this method is the possibility of monitoring the course of treatment and follow-up examinations of vascular strictures [11].

Conclusions

1. Color Doppler ultrasonography should be the first choice technique in imaging the intrabulbar tumors and their differentiation.

2. The imaging of intrabulbar vascularization in malignant melanoma and the assessment of the amplitude of blood flow velocity gives an opportunity to monitor the effectiveness of the treatment.

3. Atheromatous changes in the carotid arteries, which can cause hemodynamically essential strictures, can coexist with intraorbital tumors and their identification is important for further treatment planning.

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